REMARKS

Claims 102 and 129 have been amended. Claims 102-134 are pending in the application. Reconsideration of the application is requested in view of the amendments and the remarks to follow.

Claims 102 and 129 have been amended to address minor informalities noted during review, however, these amendments do not alter the scope of the claims.

The Examiner maintains (p. 2) that the amendment dated March 5, 2002 is objected to, alleging that it introduces new matter. Applicants do not believe the Examiner's position to be meritorious, however, in the spirit of cooperation and in order to advance the prosecution of the application, Applicants have amended the specification to conform with the ideas expressed in the Office Action.

In the previous Action, the Examiner states (p. 2) that "This application contains claims directed to the following patentably distinct *species* ...." The Examiner then expresses confusion, noting that an election was made in the Action dated March 9, 2000, "over two years ago" and indicates a lack of understanding regarding the re-introduction of these claims.

The Examiner states (p. 2) that "Applicant's election of claims 102-124, 126-131, 133 and 134 in Paper No. 25 is acknowledged. Because Applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP §818.03(a))." The Examiner is mistaken on multiple grounds,

as is explained below in more detail with reference to the prosecution history and the applicable procedures as noted in the MPEP.

The Examiner has required restriction between two different species (see Office Actions dated March 23, 2001 at p. 2 and June 28, 2001 at p. 2, the former indicating that claims 1 and 34 are generic and acknowledging Applicant's traverse at p. 3; both Actions indicating that claims 13 and 38 were withdrawn from further consideration; also in the Action dated May 1, 2002, at p. 3, acknowledging that claims 102 and 125 are generic). In the June 28, 2001 Action, the Examiner mistakenly stated that the election was without traverse, contradicting the Examiner's own statement of the previous Action reflective of the telephonic election made by Mr. Matkin on March 23, 2001 (see p. 3 of the Action dated March 23, 2001). The Response dated May 9, 2002 elects the claims of Group I (p. 2), notes that the Examiner has indicated that claims 102 and 125 are generic and that upon allowance of a generic claim, Applicants are entitled to examination of the claims of the non-elected group.

In the March 23, 2001 Action, the Examiner indicated that the claims of Group II were drawn to "the formation of a SiO_xN_y or SiN_x dielectric."

However, in an Office Action dated March 9, 2000, the Examiner required restriction (p. 4) between:

Group I: claims 1-25 and 34-51, allegedly drawn to a process of forming an oxide layer with a dielectric below 3.5; and

Group II: claims 26-33 and 52-64, allegedly drawn to a process of forming a nitride layer.

Applicants point out, to assist the Examiner in understanding the prosecution history, that claims 13 and 38 (containing subject matter analogous to claims 125 and 132) were explicitly included in the claims of the Group I of March, 2000 as defined by the PTO. Accordingly, the second restriction requirement made in the Action dated March 23, 2001 was subsequent to the first restriction requirement of March, 2000 and independent therefrom. The restriction requirement made in the Action dated May 1, 2001 is also subsequent to the first restriction requirement of March, 2000 and is similarly independent therefrom.

To further assist the Examiner in understanding the prosecution history, claims 26 and 52 were independent claims explicitly reciting forming a nitride-comprising layer. The pending generic claims 102 and 129 respectively recite "chemically vapor depositing a first layer, having a first dielectric constant, over the substrate and on the at least partially formed integrated circuitry by introducing into the reaction chamber a gaseous material precursor and a dry oxygen-comprising gaseous material while generating a plasma; and after depositing, blanket exposing the first layer to an oxygen comprising plasma effective to form the low dielectric constant insulative layer from the first layer" and "chemically vapor depositing a first layer, having a first dielectric constant, on the substrate and on the at least partially formed integrated circuitry by introducing into the reaction chamber a gaseous material

precursor and a dry oxygen-comprising gaseous material while generating a plasma; and after depositing, blanket exposing the first layer to an oxygen comprising plasma effective to form the insulative layer from the first layer and to reduce the first dielectric constant to a second dielectric constant for the insulative layer, where the second dielectric constant is in a range of about 2.5 to 2.0 and the insulative layer comprises $(CH_3)_xSiO_y$".

Claims 125 and 132 respectively depend from claims 102 and 129. Each recites that "the first layer comprises silicon atoms bonded to both organic material and nitrogen".

There is no recitation in these claims that would lead one of skill in the art to axiomatically class them as "teaching formation of a nitride layer"; i.e., falling within the ambit of the Group II claims of the restriction requirement of March 2000. Furthermore, the Office explicitly chose to place claims reciting this or analogous subject matter in Group I in that Action.

In the Actions dated March 23, 2001 (p. 2) and May 1, 2002 (p. 2), the claims of Group II are alleged to be respectively drawn to "formation of a Si_xN_y or SiN_x dielectric" or "a method of forming a low-k dielectric material having silicon, *nitrogen* and organic material", respectively. Such (i) does not accurately reflect the subject matter of these claims and (ii) is not the same as the subject matter of Group II of the original restriction requirement of March 2000.

The Examiner's error in cancellation of claims 125 and 132 is particularly egregious in light of the Examiner's own statements (Actions

dated March 23, 2001, acknowledging oral traverse and May 1, 2001; acknowledging claims 102 and 129 as generic) and Applicant's affirmation (Response dated May 22, 2001, p. 12) that the claims of Group II of the second restriction requirement remain in the application. These errors and self-contradictions on the part of the Examiner should not bind Applicants in their pursuit of patent protection for their invention.

To clarify the whether claims 102 and 129 are generic, a point that appears, based on the mutually contradictory statements of the last two Actions, to be confusing to the Examiner, Applicants refer to MPEP §806.04(d), entitled "Definition of a Generic Claim".

This MPEP section states, inter alia, that:

> It is not possible to define a generic claim with that precision existing in the case of a geometrical term. In general, a generic claim should include no material element additional to those recited in the species claims, and must comprehend within its confines the organization covered in each of the species.

The fact that the claims of Group II depend from the independent claims of Group I shows that the independent claims of Group I fit this definition of a generic claim.

This MPEP section further states that:

> For the purpose of obtaining claims to more than one species in the same case, the generic claim cannot include limitations not present in each of the added species claims. Otherwise stated, the claims to the species which can be included in a case in addition to a single species must contain all the limitations of the generic claim.

Again, the dependency relationship between the claims of Groups I and II shows that the claims of Groups I and II fit this aspect of the definition of a

generic claim. Applicants note with particularity that the Examiner has offered no evidence to the contrary.

This MPEP section further states that:

> Once a claim that is determined to be generic is allowed, all of the claims drawn to species in addition to the elected species which include all the limitations of the generic claim will ordinarily be obviously allowable in view of the allowance of the generic claim, since the additional species will depend thereon or otherwise include all of the limitations thereof. When all or some of the claims directed to one of the species in addition to the elected species do not include all the limitations of the generic claim, then that species cannot be claimed in the same case with the other species.

Again, this is not inconsistent with the relationship of these claims or with the indpendent claims of Group I being generic. Additionally, this passage shows that the statement in the present Action (p. 2) that "Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP §818.03(a))." is inapposite.

More specifically, the cited MPEP section addresses restriction between distinct inventions. This can be seen by reading the preceding section, MPEP §817, entitled "Outline of Letter for Restriction Requirement Between Distinct Inventions". Such is not the same as restriction between species.

To assist the Examiner further in understanding the types of restriction requirements that can be made and the differences in examination procedure after the restriction requirement and/or election is made, Applicants note that MPEP §809.02(c) states that:

> When the application is otherwise ready for issue and there is an allowed generic claim, and applicant has not been previously notified as to the allowance of a generic claim, applicant must be advised of the allowance of a generic claim and given a time limit of 1 month (not less than 30 days) to conform all of the claims to the nonelected species to fully embrace an allowed generic claim or the examiner will cancel the claims to each nonconforming species by examiner's amendment and pass the application to issue.

Accordingly, Applicants have demonstrated (i) that the restriction requirement was traversed, (ii) that claims 102 and 129 are generic, (iii) that the Examiner has misconstrued or falsely represented the prosecution history, (iv) that appropriate treatment of non-elected claims does not follow the path outlined by the Examiner and (v) that appropriate treatment includes holding these claims withdrawn from consideration until such time as a generic claim may be allowed.

Applicants have a right to have claims 125 and 132 considered upon allowance of the generic claims. Accordingly, the Examiner's cancellation of claims 125 and 132 is in error, is without foundation in law or regulation and improperly abridges Applicant's Constitutional property rights.

Accordingly, the Examiner should either provide a valid basis for cancellation of Applicant's claims 125 and 132, or withdraw the cancellation of these claims.

Art Rejections

Claims 102-110, 112-124, 126-131, 133 and 134 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Yau et al., U.S. Patent No.

6,072,227, in view of Morita, JP 63-157443. Claim 111 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Yau et al. and Morita, JP 63-157443, in view of Miyasaka, U.S. Patent No. 6,017,779.

Independent claims 102 and 129 recite that the exposing occurs after deposition of the dielectric layer. Support for the same is inherent from Applicant's application as filed. For example, p. 10, lns. 16-19, in reference to Fig. 2, clearly teaches that the illustrated layer 30 is subjected to the exposing after it has been formed.

The Examiner states (p. 3, referring to Fig. 8A) that Yau et al. teach forming a low k dielectric layer 510, 518 using a PECVD method with precursors such as methylsilane and an oxygen containing gas, such as O_2 or N_2O and points to col. 5, lines 35-37 to support these ideas. The Examiner is mistaken on multiple grounds.

The cited portion describes a reactor and apparatus for heating the reactor. It clearly is unrelated to the propositions for which it is cited. Clarification is requested.

Other statements regarding the reference are misdescriptive. For example, the layers 510 and 518 of Fig. 8A are stated (col. 12, line 12 et seq.) to comprise Parylene, FSG, silicon oxide or the like, and not to a chemical vapor deposited layer formed using a dry oxygen-comprising gaseous material in a plasma, as recited in Applicant's claims 102 and 129. Additionally, Yau et al. are silent as to the dielectric constant of such layers.

As such, this portion of the reference cannot possibly render these claims unpatentable.

The remainder of the statements regarding the teachings of Yau et al. are similarly garbled and misdescriptive and therefore similarly fail to elucidate how the disclosure of Yau et al. could possibly relate to the subject matter of Applicant's claims. For further example, the passage at col. 3, lines 13-29 that is cited to show porosity has no such description in it whatsoever.

Col. 15, lines 5-18 are cited for the proposition that Yau et al. teach a dielectric constant of 2.5. This portion of Yau et al.'s claims has no such disclosure and electronic search of Yau et al. indicates that "2.5" does not occur anywhere in Yau et al. Clarification of the rejection is requested.

The Examiner relies upon Yau et al. as teaching Applicant's claimed "exposing" as Yau et al. teaches plasma enhanced chemical vapor deposition (PECVD) involving an oxygen containing material and that thereby the stated "exposing" of Applicant's claims 102 and 129 occurs. Yet, there is no disclosure or suggestion that a dielectric layer being deposited, by plasma enhanced chemical vapor deposition involving an oxygen containing material, will have its dielectric constant reduced below what it was prior to the exposing.

Clearly, Applicant's claims do not encompass or contemplate the Examiner's interpretation relative to Yau et al., as Applicants, in their very disclosure, also disclosed as a preferred method of forming the interlevel dielectric layer PECVD involving an oxygen containing material. *See for*

example, p. 6, ln. 24 - p. 7, ln. 3, and p. 7, lns. 13-15. Accordingly, Applicant's application as filed clearly contemplates that which is positively recited in claims 102 and 129, namely that the exposing referred to occurs after formation of the dielectric layer.

Yau et al. is interpreted to disclose alleged exposure to an oxygen containing material only during deposition. There is absolutely no teaching or suggestion within Yau et al. of conducting the exposings of Applicant's claims 102 and 129 to a plasma comprising oxygen after the dielectric layer has been formed.

Inasmuch as the statements in the rejection bear so little relationship to what Yau et al. do teach, it is helpful to first discuss what Yau et al. actually disclose. Yau et al. teach a variety of different embodiments.

The embodiment described in col. 10, beginning at line 18, employs oxides deposited in liquid form such as reaction of methyl silane with hydrogen peroxide. Such is not representative of a "dry" oxygen material and does not teach, disclose, suggest or motivate formation of a dielectric film using a plasma as recited in claims 102 and 129.

Another embodiment is taught with reference to Figs. 6A-6D at col. 10, beginning at line 39. Such employs a lining layer 300 together with a layer 302. The layer 302 is also formed using a reaction of hydrogen peroxide (col. 11, lines 14-19 and 23-25) with silane or methylsilane (lines 14-19). Again, such does not teach, disclose, suggest or motivate formation of a dielectric

film using a dry oxygen-comprising gaseous material in a plasma as recited in claims 102 and 129.

Another embodiment is described with reference to Fig. 7 at col. 11, beginning at line 45. The description of the oxidized organo silane layer in this embodiment is vague. Yau et al. provide no description of how this layer is formed. Accordingly, this embodiment cannot possibly teach, disclose, suggest or motivate formation of a dielectric film using a dry oxygen-comprising gaseous material in a plasma as recited in claims 102 and 129.

A further embodiment is described with respect to Figs. 8A-8H at col. 12, beginning on line 6. This embodiment makes mention of a low k etch stop layer 514 but again fails to provide any description of how this layer is formed. Accordingly, this embodiment cannot possibly teach, disclose, suggest or motivate formation of a dielectric film using a dry oxygen-comprising gaseous material in a plasma as recited in claims 102 and 129.

Other embodiments are described with reference to Figs. 9 and 10. Again, the description of the oxidized organo silane layer in these embodiments is vague. Accordingly, these embodiments cannot possibly teach, disclose, suggest or motivate formation of a dielectric film using a dry oxygen-comprising gaseous material in a plasma as recited in claims 102 and 129.

An example is described beginning at col. 13, line 65 and extending to col. 14, line 23. This example does not teach, disclose, suggest or motivate "after depositing, blanket exposing the first layer to an oxygen comprising

plasma effective to form the low dielectric constant insulative layer from the first layer and to reduce the first dielectric constant to a second dielectric constant that is the relatively low dielectric constant for the insulative layer", as recited in claim 102.

Further, none of these embodiments teach, disclose, suggest or motivate "after depositing, blanket exposing the first layer to an oxygen comprising plasma effective to form the insulative layer from the first layer and to reduce the first dielectric constant to a second dielectric constant for the insulative layer, where the second dielectric constant is in a range of about 2.5 to 2.0 and the insulative layer comprises $(CH_3)_xSiO_y$", as recited in claim 129.

Accordingly, none of the embodiments of Yau et al. can possibly provide the invention as recited in claims 102 or 129. The teachings of Morita fail to cure the deficiencies of Yau et al.

More specifically, Morita teaches formation of a CVD silicon dioxide film 9. Morita teaches coating this with a solution containing organic silicon in order to alleviate unevenness (pp. 4-5 of the translation). As such, Morita cannot possibly teach, disclose, suggest or motivate formation of a dielectric film using a dry oxygen-comprising gaseous material in a plasma as recited in claims 102 and 129.

Morita is silent with respect to dielectric constants. As such, Morita cannot possibly teach, disclose, suggest or motivate "after depositing, blanket exposing the first layer to an oxygen comprising plasma effective to form the

low dielectric constant insulative layer from the first layer and to reduce the first dielectric constant to a second dielectric constant that is the relatively low dielectric constant for the insulative layer", as recited in claim 102.

Similarly, Morita cannot possibly teach, disclose, suggest or motivate "after depositing, blanket exposing the first layer to an oxygen comprising plasma effective to form the insulative layer from the first layer and to reduce the first dielectric constant to a second dielectric constant for the insulative layer, where the second dielectric constant is in a range of about 2.5 to 2.0 and the insulative layer comprises $(CH_3)_xSiO_y$", as recited in claim 129.

Further, there is absolutely no teaching or suggestion within Yau et al. or Morita that exposing a previously formed interlevel dielectric layer comprising $(CH_3)_xSiO_y$ to an oxygen containing plasma would have any effect on the dielectric constant, let alone the magnitude lowering which Applicant recites in claims 102 and 129, or that such would achieve the specific range of dielectric constants recited in claim 129.

Miyasaka teaches methods for depositing thin films of semiconductors. The teachings of Miyasaka are unrelated to the subject matter of the instant application, and there is no guidance in Miyasaka to assist one of skill in the art in determining which of Miyasaka's teachings to "pick and choose" to adapt to attempt to arrive at the subject matter of Applicant's claims. At best, the selection of teachings from Miyasaka is carried out using an inappropriate "obvious to try" approach coupled with impermissible hindsight. Such is

improper and does not provide unpatentability, as is discussed in MPEP §2145(x)(A) and (B).

As a result, the proposed combination does not and cannot provide the invention as recited in any of Applicant's claims and thus cannot render Applicant's claims unpatentable. This is described in more detail below with reference to MPEP §2142, entitled "Legal Concept of Prima Facie Obviousness".

This MPEP section states that in order to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. There is no motivation identified anywhere to modify the references to attempt to arrive at the subject matter of Applicant's claims.

This MPEP section also states: "Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest **all** the claim limitations." As noted above, neither Yau et al. nor Morita provide any teaching, disclosure, suggestion or motivation for Applicant's affirmative recitations of formation of a dielectric film using a dry oxygen-comprising gaseous material, or for "after depositing, blanket exposing the first layer to an oxygen comprising plasma effective to form the insulative layer from the first layer and to reduce the first dielectric

constant to a second dielectric constant". Thus, the third prong of the test cannot be met.

As a result, there cannot possibly be a reasonable expectation of success from combining their teachings to attempt to arrive at the subject matter as recited in any of Applicant's claims. The rejection fails all three prongs of the test set forth in the MPEP for forming a prima facie case of obviousness.

This MPEP section further states that "The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)." Since neither of these prongs of the test are met at all, such can hardly be found in the prior art.

Accordingly, the rejection of claims 102-134 is plainly defective and should be withdrawn, and claims 102-134 should be allowed.

Additionally, substituting Applicant's affirmatively-recited chemical vapor deposition for the spin-on glass of Morita renders the teachings of Morita unsatisfactory for their intended purpose. Similarly, substituting the PECVD layers taught by Yau et al. for the spin-on glass of Morita renders the teachings of Morita unsatisfactory for their intended purpose.

Morita teaches formation of a CVD silicon dioxide film 9. Morita teaches coating this with a solution containing organic silicon in order to alleviate unevenness (pp. 4-5 of the translation). Morita teaches that CVD

dielectrics do not provide the planarization that is Morita's *raison d'etre* (see p. 4 of the translation where Morita teaches a spin-on glass layer atop a CVD layer).

Combining teachings from references in a fashion that makes the teachings of a reference unsuitable for their intended purpose is improper. This is explained in MPEP §2143.01, entitled "Suggestion or Motivation to Modify the References". This MPEP section states that "THE PROPOSED MODIFICATION CANNOT RENDER THE PRIOR ART UNSATISFACTORY FOR ITS INTENDED PURPOSE". This MPEP section further states that "If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)."

Accordingly, there is no motivation, as a matter of law, to combine the teachings of Morita with anything to attempt to arrive at the subject matter of Applicant's claims.

Further, no evidence has been provided as to why it would be obvious to combine or modify the teachings of these references. Evidence of a suggestion to combine may flow from the prior art references themselves, from the knowledge of one skilled in the art, or from the nature of the problem to be solved. However, this range of sources does not diminish the requirement for actual evidence. Further, the showing must be clear and particular. See *In re Dembiczak*, 175 F.3d 994, 998 (Fed. Cir. 1999).

For at least these reasons, the rejection of claims 102-134 is defective and should be withdrawn, and claims 102-134 should be allowed.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page(s) are captioned "**Version with markings to show changes made**."

In view of the foregoing, allowance of claims 102-134 is requested. The Examiner is requested to phone the undersigned in the event that the next Office Action is one other than a Notice of Allowance. The undersigned is available for telephone consultation at any time during normal business hours (Pacific Time Zone).

Respectfully submitted,

Dated: Sept. 3, 2002 By: _____

Frederick M. Fliegel, Ph.D.
Reg. No. 36,138

Version with markings to show changes made

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No. 09/388,826
Filing Date ..... September 1, 1999
Inventor ..... Weimin Li et al.
Assignee ..... Micron Technology, Inc.
Group Art Unit 2813
Examiner ..... E.J. Kielin
Attorney's Docket No. MI22-1208
Title: Low k Interlevel Dielectric Layer Fabrication Methods

37 CFR §1.121(b)(1)(iii) AND 37 CFR §1.121(c)(1)(ii) FILING REQUIREMENTS TO ACCOMPANY RESPONSE TO JUNE 4, 2002 OFFICE ACTION

Deletions are bracketed, additions are underlined.

In the Specification

The paragraph spanning from page 7, line 20, to page 8, line 15, has been amended as shown below:

In a more specific example, methylsilane or trimethylsilane is combined with N_2O in a reaction chamber. A pressure within the chamber is maintained at from about 300 mTorr to about 30 Torr, and is preferably maintained at from about 1 Torr to about 10 Torr. An exemplary reaction chamber comprises a spacing [between the plates of] from about 400 mils to about 600 mils with methylsilane being flowed into the chamber at a rate from about 25 standard cubic centimeters per minute (sccm) to about 2000 sccm (preferably at from about 50 sccm to about 250 sccm). The N_2O is flowed into the reaction chamber at a rate from about 50 sccm to about 3000 sccm (preferably at a rate from about 100 sccm to about 1500 sccm, and more preferably at a rate of from about 500 sccm to about 1200 sccm); and, additionally, helium is flowed into the reaction chamber at a rate of about 500 sccm to about 5000 sccm (preferably from 1000 sccm to about 3000 sccm). A radio frequency (RF) power within the chamber is maintained at from about 50 watts to about 500 watts, and preferably from about 100 watts to about 200 watts. The semiconductor substrate (such as a monocrystalline silicon wafer) is provided within the chamber and maintained at a temperature from about 25° C to about 450° C.

In the Claims

102. (Amended) A method for forming an insulative layer having a relatively low dielectric constant comprising:

loading a substrate including at least partially formed integrated circuitry thereon into a reaction chamber for a chemical vapor deposition apparatus;

with the substrate in the reaction chamber, chemically vapor depositing a first layer, having a first dielectric constant, over the substrate and on the at least partially formed integrated circuitry by introducing into the reaction chamber a gaseous material precursor and a dry oxygen-comprising gaseous material while generating a plasma; and

after depositing, blanket exposing the first layer to an oxygen comprising plasma effective to form the low dielectric constant insulative layer from the first layer and to reduce the first dielectric constant to a second dielectric constant that is the relatively low dielectric constant for the insulative layer.

129. (Amended) A method for forming an insulative layer having a low dielectric constant comprising:

loading a substrate including at least partially formed integrated circuitry thereon into a reaction chamber for a chemical vapor deposition apparatus;

with the substrate in the reaction chamber, chemically vapor depositing a first layer, having a first dielectric constant, on the substrate and on the at least partially formed integrated circuitry by introducing into the reaction chamber a gaseous material precursor and a dry oxygen-comprising gaseous material while generating a plasma; and

after depositing, blanket exposing the first layer to an oxygen comprising plasma effective to form the insulative layer from the first layer and to reduce the first dielectric constant to a second dielectric constant for the insulative layer, where the second dielectric constant is in a range of about 2.5 to 2.0 and the insulative layer comprises $(CH_3)_xSiO_y$.

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